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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/603,132	06/23/2000	Brian A. Vaartstra	150.00650102	3538

7590 12/05/2008

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ART UNIT	PAPER NUMBER
2815	

MAIL DATE	DELIVERY MODE
12/05/2008	PAPER

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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte BRIAN A. VAARTSTRA and EUGENE P. MARSH

Appeal 2008-5621
Application 09/603,132
Technology Center 2800

Decided: December 5, 2008

Before MAHSHID D. SAADAT, ROBERT E. NAPPI,
and SCOTT R. BOALICK, *Administrative Patent Judges.*

NAPPI, *Administrative Patent Judge.*

DECISION ON APPEAL

This is a decision on appeal under 35 U.S.C. § 6(b) of the final rejection of claims 45 through 74.

We affirm-in-part the Examiner's rejections of these claims.

INVENTION

The invention is directed towards a method of forming $RuSi_x$ diffusion barriers in the fabrication of integrated circuits. See page 3 of Appellants' Specification. Claim 45 is representative of the invention and reproduced below:

> 45. A semiconductor device structure, the structure comprising:
> a substrate assembly including a surface; and
> a chemical vapor codeposited diffusion barrier layer over at least a portion of the surface, wherein the diffusion barrier layer is formed of $RuSi_x$, where x is in the range of about 0.01 to about 10.

REFERENCES

Agostinelli	US 5,017,551	May 21, 1991
Matsubara	US 5,122,923	Jun. 16, 1992
Lee	US 5,872,041	Feb. 16, 1999 (filed Sep. 18, 1997)
Lee	US 5,897,350	Apr. 27, 1999 (filed Dec. 24, 1996)
Komatsu	US 5,907,789	May 25, 1999 (filed Oct. 2, 1997)
Kuroiwa	US 6,239,460 B1	May 29, 2001 (filed Jun. 28, 1996)

REJECTIONS AT ISSUE

Claims 45 through 48 and 54 through 59 are rejected by the Examiner under 35 U.S.C. § 102(e) as being anticipated by Komatsu. The Examiner's rejection is on page 4 of the Answer[1].

Claims 45, 46, 50, 51, 57 through 59, and 63 through 65 are rejected by the Examiner under 35 U.S.C. § 103(a) as being unpatentable over Kuroiwa in view of Agostinelli. The Examiner's rejection is on page 5 of the Answer.

Claims 48, 49, 54, 55, and 69 through 74 are rejected by the Examiner under 35 U.S.C. § 103(a) as being unpatentable over Kuroiwa in view of Agostinelli and Lee ('041). The Examiner's rejection is on page 6 of the Answer.

Claims 52 and 53 are rejected by the Examiner under 35 U.S.C. § 103(a) as being unpatentable over Kuroiwa in view of Agostinelli, Lee ('041), and Matsubara. The Examiner's rejection is on page 7 of the Answer.

Claims 60 through 62 and 66 through 68 are rejected by the Examiner under 35 U.S.C. § 103(a) as being unpatentable over Kuroiwa in view of Agostinelli and Lee ('350). The Examiner's rejection is on page 7 of the Answer.

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[1] Throughout the opinion, we make reference to the Answer, mailed June 4, 2007 for the respective details thereof.

ISSUES

Rejection under 35 U.S.C. § 102(e)

Appellants argue, on pages 6 through 12 of the Brief,[2] that the rejection under 35 U.S.C. § 102(e) is in error. Appellants reason that Komatsu does not provide an enabling disclosure of a chemical vapor deposition diffusion barrier layer formed of $RuSi_x$ and as such does not anticipate the claim.

Thus, Appellants' contentions with respect to the rejection under 35 U.S.C. § 102(e) present us with the issue of whether Appellants have shown that Komatsu does not provide an enabling disclosure of a chemical vapor deposition diffusion barrier layer made of $RuSi_x$.

Rejections under 35 U.S.C. § 103(a)

Appellants argue, on pages 12 through 17 of the Brief, that the rejection by the Examiner based on Kuroiwa in view of Agostinelli is in error. Appellants reason that Kuroiwa does not provide an enabling disclosure of a chemical vapor deposition diffusion barrier layer formed of $RuSi_x$ and as such does not render obvious the claim. Appellants present similar arguments directed to the other rejections based upon Kuroiwa in view of Agostinelli in combination with the disclosure of Lee ('041), Lee (350), and Matsubara.

Thus, Appellants' contentions with respect to the rejections under 35 U.S.C. § 103(a) present us with the issue of whether Appellants have shown

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[2] Throughout the opinion, we make reference to the Brief, received December 18 2006 for the respective details thereof.

that Komatsu does not provide an enabling disclosure of a chemical vapor deposition diffusion barrier layer made of $RuSi_x$.

PRINCIPLES OF LAW

A rejection based upon section 102 requires that the prior art disclose, expressly or inherently, every limitation of the claim. *In Re King*, 801 F.2d 1324, 1326 (Fed. Cir. 1986). Under section 102 a prior art reference must also sufficiently describe the claimed invention to have placed the public in possession of it. *In Re Donohue*, 766 F.2d 531, 533 (Fed. Cir. 1985). "Such possession is effected if one of ordinary skill in the art could have combined the publication's description of the invention with his own knowledge to make the claimed invention." *Id.* Thus, "even if the claimed invention is disclosed in a printed publication, that disclosure will not suffice as prior art if it was not enabling." *Id.* The Examiner bears the burden of presenting a prima facie case of anticipation. *In re King*, 801 F.2d at 1327. Once the PTO establishes a prima facie case of anticipation based on inherency, the burden shifts to Appellants to prove error in the Examiner's rejection. Thus, to overcome a prima facie anticipation rejection by the Examiner it is incumbent upon the Appellants to demonstrate and provide evidence[3] that the disclosure of the prior art reference is non-enabling of the claimed invention. *See In re Sasse*, 629 F.2d 675, 681-82 (C.C.P.A. 1980); *In re Spence*, 261 F.2d 244, 246, (C.C.P.A. 1958). Thus analysis similarly applies to obviousness rejections under section 103. *See In re Hoeksema,* 399 F.2d 269, 275 (C.C.P.A. 1968) (applying a similar analysis to an obviousness rejection).

FINDINGS OF FACT

1. The Examiner has found that Komatsu teaches a substrate with a metal silicide diffusion barrier layer where the metal is ruthenium. Further, the Examiner finds that Komatsu teaches several methods of forming the silicide barrier, including chemical vapor growth. Answer 4.
2. Komatsu teaches a semiconductor device that has a contact hole which includes a metal silicide layer (layer 86 in figures 5F and 5G, unnumbered in figures 7A-7C). Col. 19, 59-61.
3. Komatsu teaches several embodiments, in the sixth embodiment the silicide layer is formed by a reaction between a metal layer and a silicon layer when the material is heated (an annealing process). Col. 18, l. 56- col. 19, l. 6.
4. In Komatsu's seventh embodiment, Komatsu teaches that the silicide layer is made by a chemical vapor growth method. Komatsu teaches that the growth is made by using gasses containing SiH_4 and a source gas for the metal is reduced by H_2 to form the layer. Thus, Komatsu teaches growing the silicide layer by a codeposition process. Col. 22, ll. 31-44.
5. Komatsu teaches that the metal used in the silicide layer can be ruthenium. Col. 22, ll. 36.
6. The Examiner finds that Kuroiwa teaches a semiconductor capacitor with an electrode which includes a layer formed of ruthenium silicide. The Examiner also finds that Kuroiwa does not teach forming this layer by a chemical vapor diffusion. Answer 5.

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[3] This evidence is typically in the form of affidavits and declarations.

7. Kuroiwa teaches a ruthenium silicide layer (item 132, figs. 8, 10). This layer is formed by depositing ruthenium using an ion sputtering chemical vapor deposition and then subjecting the layer to a heat treatment to form the silicide (i.e., an annealing process). Col. 12, ll. 35-49, col. 13, ll. 7-18.
8. The Examiner finds that Agostinelli teaches using chemical vapor deposition for forming a metal silicide layer. Answer 5.
9. Agostinelli teaches forming a barrier layer from a silicide made with a metal of the platinum group (which includes ruthenium). Col. 4, ll. 21-33.
10. Agostinelli teaches that the silicide is made by forming a metal barrier layer on a substrate of silicon. The layers are then heated to produce silicide layers (i.e. an annealing process). Col. 19, ll. 48-55.
11. Agostinelli also states that the barrier layer (unclear which layer and of what material) can be formed by other processes such as metal organic chemical vapor deposition. Col. 20, ll. 11-16.

ANALYSIS

Rejection under 35 U.S.C. § 102(e)

Appellants' arguments have not persuaded us of error in the Examiner's rejection of claims 45 through 48 and 54 through 59 as being anticipated by Komatsu. The Examiner has found that Komatsu teaches forming diffusion barrier layer of $RuSi_x$ by chemical vapor deposition. Fact 1. We find that the evidence supports this finding. Facts 2, 4, and 5. Komatsu teaches that the silicide layer can be formed by annealing a metal layer, Fact 3, or by codeposition, Fact 4. As identified above, Appellants

have not challenged the Examiner's finding that Komatsu teaches a $RuSi_x$ diffusion barrier, rather Appellants challenge whether Komatsu provides an enabling disclosure of how to produce a $RuSi_x$ barrier. Thus, in the absence of evidence to the contrary, we consider the Examiner to have established a prima facie case of anticipation, and the burden is on Appellants to show that the disclosure of Komatsu does not provide an enabling disclosure of forming "a chemical vapor codeposited diffusion barrier layer over at least a portion of the surface, wherein the diffusion barrier layer is formed of $RuSi_x$" as recited in representative claim 45[4].

Appellants have not met the burden of showing that Komatsu does not provide an enabling disclosure of forming a codeposited diffusion barrier of $RuSi_x$. Appellants' arguments on pages 10 through 12 of the Brief focus on Komatsu's disclosure of several specific processes to form silicide barriers with metals other than Ruthenium. The thrust of Appellants' argument is that since Komatsu teaches the specific process (and precursor chemicals used) in forming some silicide barriers disclosed, but not all, the disclosure is not enabling for the formation of silicide barriers where the specific process is not disclosed. These arguments are not persuasive. While we agree with Appellants that Komatsu does not provide an example of the process and precursor chemicals used to create the codeposition layer, Appellants have not provided evidence to show that knowledge of such process and chemicals was outside the knowledge of the skilled artisan. Thus, Appellants have not shown that the skilled artisan could not have

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[4] Appellants' arguments group claims 45 through 48 and 54 through 59 together, accordingly we select claim 45 as representative of the group of claims.

combined Komatsu's description with his own knowledge to make the claimed invention (i.e., Appellants have not shown that the disclosure is not enabling). Accordingly, Appellants have not shown that Komatsu does not provide an enabling disclosure of a chemical vapor deposition diffusion barrier layer made of $RuSi_x$, and we sustain the Examiner's rejection of claims 45 through 48 and 54 through 59 under 35 U.S.C. § 102(e) as being anticipated by Komatsu.

Rejections under 35 U.S.C. § 103(a)

Appellants arguments have persuaded us of error in the Examiner's rejections under 35 U.S.C. § 103(a). In applying these rejections, the Examiner has found that Kuroiwa teaches forming a ruthenium silicide layer, but not that the layer is formed by chemical vapor diffusion. Fact 6. Further, The Examiner has found that Agostinelli teaches forming a ruthenium silicide layer by chemical vapor deposition. Fact. 8. Appellants' arguments directed to these rejections focus on Agostinelli not providing an enabling disclosure of forming a ruthenium silicide layer by chemical vapor codeposition.

We concur with Appellants' arguments, because we do not find that Agostinelli provides any disclosure of forming a ruthenium silicide layer by chemical vapor codeposition. Independent claims 45, 49, 50, 52, 54, 57, 60, 63, 66, and 69 all include a limitation directed to a chemical vapor co-deposited diffusion barrier layer formed of $RuSi_x$. Appellants' Specification on pages 8 and 9 describes the codeposition process as one in which precursor chemicals for silicon and ruthenium are introduced to the substrate in a chemical vapor process. See Appellants' Specification page 8.

We find that Agostinelli teaches forming a diffusion barrier made of a metal silicide where the metal is ruthenium. Fact 9. Agostinelli teaches that the metal is deposited on a silicon layer and then heat treated to produce the silicide layer by an annealing process. Fact 10. The annealing process differs from codeposition in that the metal is deposited on the silicon, where as in codeposition the metal and silicon are codeposited. Further, while we recognize that Agostinelli states that the barrier may be formed by organic chemical vapor deposition, it is unclear whether Agostinelli is referring to the silicide or metal barrier. As such, we do not find that Agostinelli teaches forming a chemical vapor codeposited diffusion barrier made of ruthenium silicide.

Accordingly we will not sustain the Examiner's rejection of claims 45, 46, 50, 51, 57 through 59, and 63 through 65 under 35 U.S.C. § 103(a) as being unpatentable over Kuroiwa in view of Agostinelli.

The Examiner has not found, nor do we find that the additional teachings of Lee ('041), Matsubara, or Lee ('350) teach forming a chemical vapor codeposited diffusion barrier ruthenium silicide. Thus, we similarly will not sustain the Examiner's rejections of claim 48, 49, 52 through 55, 60 through 62, and 66 through 74 under 35 U.S.C. § 103(a).

SUMMARY

In summary, we sustain the Examiner's rejection of claims 45 through 48, and 54 through 59 under 35 U.S.C. § 102(e) as being anticipated by Komatsu. However, we reverse the Examiner's rejections of claims 45, 46, 48 through 55, and 57 through 74 under 35 U.S.C. § 103(a) based upon the teachings Kuroiwa in view of Agostinelli.

ORDER

The decision of the Examiner to reject claims 45 through 74 is affirmed-in-part.

No period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(iv).

AFFIRMED-IN-PART

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